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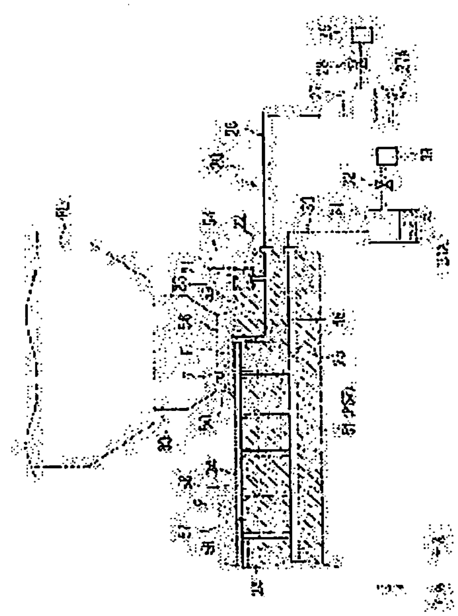
(54) ALIGNER, EXPOSURE METHOD, AND MANUFACTURING METHOD OF DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide an aligner for precision pattern transfer with fluctuation in environment being suppressed even if a liquid flows to the outside of a substrate when an exposure process is made by an immersion method.
SOLUTION: The image plane side of a projection optical system PL is partially filled with a liquid 50, and the image of a pattern is projected on a substrate P through the liquid 50 and the projection optical system PL, thus the substrate P is exposed. A collecting device 20 collects the liquid 50 flowing outside the substrate P.



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CLAIMS

[Claim(s)]
[Claim 1]
It is the aligner which imprints the image of a pattern on a substrate through a liquid, and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate,
The aligner characterized by having the recovery system which collects the liquids which flowed into the outside of said substrate.
[Claim 2]
It is the aligner according to claim 1 which is equipped with the substrate stage holding said substrate, and is characterized by said recovery system having the stripping section prepared in said substrate stage.
[Claim 3]
The stripping section of said recovery system is an aligner according to claim 2 characterized by being arranged at a part of perimeter [at least] of the attaching part of a substrate established in said substrate stage.
[Claim 4]
The stripping section of said recovery system is an aligner according to claim 2 or 3 characterized by including the liquid absorption member arranged on said substrate stage.
[Claim 5]
Said liquid absorption member is an aligner according to claim 4 characterized by including a porosity member.
[Claim 6]
The stripping section of said recovery system is an aligner given in any 1 term of claims 2-5 characterized by including the liquid recovery slot arranged on said substrate stage.
[Claim 7]
The stripping section of said recovery system is an aligner given in any 1 term of claims 2-6 characterized by including the recovery hole prepared in said substrate stage.
[Claim 8]
Said recovery system is an aligner given in any 1 term of claims 2-7 characterized by collecting the liquids which turned to the rear-face side of said substrate held on said substrate stage.
[Claim 9]
Said recovery system is an aligner given in any 1 term of claims 2-8 characterized by discharging the liquid collected by said stripping section when said substrate stage comes to a substrate exchange location.
[Claim 10]
An aligner given in any 1 term of claims 2-9 characterized by having an aspirator for attracting the liquid collected by the stripping section of said recovery system.
[Claim 11]
An aligner given in any 1 term of claims 2-10 characterized by having the tank which collects the liquids collected by the stripping section of said recovery system.
[Claim 12]
It is an aligner given in any 1 term of claims 1-11 characterized by said feeder increasing the amount of supply of a liquid when it has the feeder which supplies a liquid between said projection optics and said substrates and the immersion part between said projection optics and said substrates is near the periphery of said substrate.
[Claim 13]
It is an aligner given in any 1 term of claims 1-12 characterized by said 2nd recovery system reducing the amount of recovery of a liquid when it has the 2nd recovery system which collects the liquids on said substrate and the immersion part between said projection optics and said substrates is near the periphery of said substrate.
[Claim 14]
The substrate stage holding said substrate is an aligner given in any 1 term of claims 1-13 characterized by having the 3rd recovery system which collects the liquids which have an adsorption hole for carrying out adsorption maintenance of said substrate, flowed into the outside of said substrate, and flowed into said adsorption hole.
[Claim 15]
Said 3rd recovery system is an aligner according to claim 14 characterized by having the eliminator which separates the gas which flowed from said adsorption hole, and a liquid.
[Claim 16]
Said recovery system is an aligner of claim 1-15 characterized by having the eliminator which separates the collected liquid and the gas collected with the liquid given in any 1 term.
[Claim 17]
Furthermore, an aligner given in any 1 term of claims 1-16 characterized by having the 2nd recovery system which collects the liquids on said substrate from the upper part of said substrate.
[Claim 18]
claim 1- characterized by collecting almost all the liquids that were equipped with the liquid feeder which supplies a liquid on said substrate from the upper part of said substrate, and were supplied on said substrate with said recovery system --

an aligner given in 11 or 16 any 1 terms.
[Claim 19]
It is the aligner which imprints the image of a pattern on a substrate through a liquid, and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate,
The liquid feeder style which supplies a liquid from the upper part of said substrate,
It has the recovery system which collects the liquids supplied from said liquid feeder style,
Said recovery system is an aligner which does not collect liquids from the upper part of said substrate.
[Claim 20]
It is the aligner which imprints the image of a pattern on a substrate through a liquid, and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate,
The inhalation-of-air system which has an inlet,
An aligner equipped with the recovery system which collects the liquids attracted from this inlet.
[Claim 21]
Said recovery system is an aligner according to claim 20 characterized by separating the liquid attracted from said inlet, and a gas.
[Claim 22]
Said inlet is an aligner according to claim 20 or 21 formed in order to hold a body in a predetermined location.
[Claim 23]
Furthermore, the aligner according to claim 22 which it has a substrate stage and said body is a substrate, and is formed in said substrate stage in order that said inlet may carry out adsorption maintenance of the substrate.
[Claim 24]
It is the aligner which imprints the image of a pattern on a substrate through a liquid, and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate,
The substrate stage holding said substrate,
An aligner equipped with the recovery system which at least a part is prepared in said substrate stage, and collects liquids.
[Claim 25]
Said recovery system is an aligner according to claim 24 which collects the liquids which turned to the rear face of said substrate.
[Claim 26]
Said recovery system is an aligner according to claim 24 which has a stripping section on the top face of said substrate stage.
[Claim 27]
Said substrate stage has an attaching part holding the rear face of said substrate,
Said recovery system is an aligner according to claim 26 which has still more nearly another stripping section in said attaching part.
[Claim 28]
Said recovery system is an aligner of claim 24-27 containing a liquid absorption member given in any 1 term.
[Claim 29]
Said recovery system is an aligner of claim 24-28 which has the slot established in said substrate stage given in any 1 term.
[Claim 30]
Said recovery system is an aligner of claim 24-29 which has the eliminator which separates the collected liquid with a gas given in any 1 term.
[Claim 31]
The liquid collected with said recovery system is the aligner of claim 24-30 discharged when said substrate stage moves to a predetermined location given in any 1 term.
[Claim 32]
Said predetermined location is an aligner including a substrate exchange location according to claim 31.
[Claim 33]
It has further the interferometer mirror prepared in said substrate stage,
The liquid stripping section of said recovery system is the aligner of claim 24-32 arranged near said interferometer mirror given in any 1 term.
[Claim 34]
The device manufacture approach characterized by using the aligner of a publication for any 1 term of claims 1-33.
[Claim 35]
It is the exposure approach which exposes a substrate by imprinting the image of a predetermined pattern on a substrate according to projection optics,
From the upper part of a substrate to supplying a liquid between said projection optics and said substrates
Said supplied liquids are collected from the location lower than a substrate which is the outside of a substrate,
The exposure approach including exposing said substrate, while supply and recovery of said liquid are performed.
[Claim 36]
Furthermore, the exposure approach including collecting said supplied liquids from the upper part of a substrate according to claim 35.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[Field of the Invention]
[0001]
This invention relates to the aligner exposed by the image of the pattern which projected the image surface side of projection optics according to projection optics in the condition of having filled with the liquid locally and the exposure approach, and the device manufacture approach using this aligner.
[Background of the Invention]
[0002]
A semiconductor device and a liquid crystal display device are manufactured by the technique of the so-called photolithography which imprints the pattern formed on the mask on a photosensitive substrate. The aligner used at this photolithography process has the mask stage which supports a mask, and the substrate stage which supports a substrate, and it imprints the pattern of a mask to a substrate through projection optics, moving serially on a mask stage and a substrate stage. Since it corresponds to much more high integration of a device pattern in recent years, the further high resolution-ization of projection optics is desired. The resolution of projection optics becomes so high that the numerical aperture of projection optics is so large that the exposure wavelength to be used becomes short. Therefore, exposure wavelength used with an aligner is short-wavelength-ized every year, and the numerical aperture of projection optics is also increasing. And although the exposure wavelength of the current mainstream is 248nm of KrF excimer laser, no less than 193nm of the ArF excimer laser of short wavelength is being put further in practical use. Moreover, in case it exposes, the depth of focus (DOF) as well as resolution becomes important. Resolution R and the depth of focus delta are expressed with the following formulas, respectively.
[0003]
R=k1 and lambda/NA -- (1)
delta=**k2 and lambda/NA 2 -- (2)
Here, the numerical aperture of projection optics, and k1 and k2 is [lambda of exposure wavelength and NA] process multipliers. (1) In order to raise resolution R, when exposure wavelength lambda is shortened and numerical aperture NA is enlarged from a formula and (2) types, it turns out that the depth of focus delta becomes narrow.
[0004]
When the depth of focus delta becomes narrow too much, it becomes difficult to make a substrate front face agree to the image surface of projection optics, and there is a possibility that the focal margins at the time of exposure actuation may run short. Then, the immersion method which considers as the approach of shortening exposure wavelength substantially and making the depth of focus large, for example, is indicated by the international public presentation/[99th] No. 49504 official report is proposed. This immersion method expands the depth of focus by about n times while it improves resolution using filling between the inferior surface of tongue of projection optics, and substrate front faces with liquids, such as water and an organic solvent, and the wavelength of the exposure light in the inside of a liquid being set to 1/n in air (n being usually 1.2 to about 1.6 at the refractive index of a liquid).
[Patent reference 1] International public presentation/[99th] No. 49504 pamphlet
[Description of the Invention]
[Problem(s) to be Solved by the Invention]
[0005]
By the way, the problem described below exists in the above-mentioned conventional technique. The above-mentioned conventional technique is the configuration of filling locally between the inferior surface of tongue by the side of the image surface of projection optics, and substrates (wafer) with a liquid, and in exposing the shot field near the center of a substrate, it does not produce an outflow on the substrate outside of a liquid. However, if the boundary region (edge field) E of Substrate P tends to be moved to the projection field 100 of projection optics and it is going to expose the edge field E of this substrate P as shown in the mimetic diagram shown in drawing 14 , a liquid will flow into the outside of Substrate P. If this liquid that flowed out is left, fluctuation of the environments (humidity etc.) where Substrate P has set will be brought about, and a possibility that it may become impossible for causing change of the refractive index on the optical path of the interferometer which measures the substrate stage positional information holding Substrate P, and the optical path of the detection light of various optical detection equipments etc. to acquire a desired pattern imprint precision will arise. Furthermore, it also produces un-arranging, such as making the machine part around a substrate stage which supports Substrate P produce **** with the liquid which flowed out etc. Although making it not make a liquid flow out by not exposing the edge field E of Substrate P is also thought of, if exposure processing is performed to the edge field E and a pattern is not formed in it, another problem that where of the substrate P which is a back process and which is a wafer carries out per piece to the polished surface of CMP equipment at the time of CMP (chemical mechanical polish) processing, for example, and it cannot grind good will arise. Furthermore, there was also a possibility that the vacuum pump with which it will serve as a source of a vacuum if the liquid which flowed out permeates into tubing of a vacuum system (inhalation-of-air system) might damage or break down.
[0006]
This invention is made in view of such a situation, and when filling a liquid and carrying out exposure processing of

between projection optics and substrates, it aims at offering the aligner which precision can improve a pattern imprint and the exposure approach, and the device manufacture approach of using this aligner for a list.
[Means for Solving the Problem]
[0007]
In order to solve the above-mentioned technical problem, this invention has adopted the configuration of the following matched with drawing 1 shown in the gestalt of operation - drawing 13 . However, it does not pass over the sign with a parenthesis given to each element to instantiation of the element, but there is no intention which limits each element.
[0008]
If the 1st mode of this invention is followed, it will be the aligner which imprints the image of a pattern on a substrate (P) through a liquid (50), and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate (PL),
An aligner (EX) equipped with the recovery system (20) which collects the liquids which flowed into the outside of said substrate is offered.
[0009]
According to this invention, even if a liquid flows into the outside of a substrate, this liquid that flowed out is recovered by the recovery system, without being left. therefore, the machine part around a substrate stage which supports a substrate while fluctuation of the environment where the substrate is set is suppressed -- rusting -- etc. -- since inconvenient generating of generating is also suppressed, precision can improve a pattern imprint to a substrate and the device which has a high pattern precision can be manufactured.
[0010]
If the 2nd mode of this invention is followed, it will be the aligner which imprints the image of a pattern on a substrate through a liquid (50), and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate (PL),
The liquid feeder style which supplies a liquid from the upper part of said substrate (1),
It has the recovery system (20) which collects the liquids supplied from said liquid feeder style (1),
The aligner (EX) with which said recovery system does not collect liquids from the upper part of said substrate is offered.

[0011]
According to this invention, even if it is not from the upper part of a substrate, it is recoverable in a liquid (suction). So, it can prevent that a sound and vibration occur during exposure of a substrate. moreover, fluctuation of the environment where the substrate is placed since the liquid which flowed into the outside of a substrate is recovered by the recovery system and a machine part -- rusting -- etc. -- generating can be prevented. Therefore, a pattern can be formed with a precision sufficient to a substrate, and the device which has a high pattern precision can be manufactured.
[0012]
If the 3rd mode of this invention is followed, it will be the aligner which imprints the image of a pattern on a substrate (P) through a liquid (50), and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate (PL),
The inhalation-of-air system which has an inlet (24, 32, 33),
An aligner (EX) equipped with the recovery system which collects the liquids attracted from this inlet is offered.
[0013]
According to this invention, even if a liquid flows out, for example and a liquid flows into the inlet of an inhalation-of-air system, the liquids are collected and permeation of the liquid to the source of a vacuum as a source of the inhalation of air is prevented. So, even if it performs immersion exposure, the function of an inhalation-of-air system can be guaranteed, a substrate can be certainly exposed by the highly precise pattern, and a device can be manufactured.
[0014]
If the 4th mode of this invention is followed, it will be the aligner which imprints the image of a pattern on a substrate (P) through a liquid (50), and exposes a substrate,
Projection optics which projects the image of a pattern on a substrate (PL),
The substrate stage holding said substrate (PST),
At least a part is prepared in said substrate stage, and an aligner equipped with the recovery system (20) which collects liquids is offered. fluctuation of the environment where, as for the aligner of this invention, the substrate is placed, and a machine part -- rusting -- etc. -- generating can be prevented.
[0015]
If the 5th mode of this invention is followed, it will be the exposure approach which exposes a substrate by imprinting the image of a predetermined pattern on a substrate according to projection optics,
From the upper part of a substrate to supplying a liquid between said projection optics and said substrates
By collecting said supplied liquids from the location lower than a substrate which is the outside of a substrate, and the exposure approach of this invention, since liquids are collected from the lower part from the maintenance location of a substrate while supplying a liquid from the upper part of a substrate in case immersion exposure is performed, it can prevent effectively that a sound and vibration occur during exposure of a substrate.
While supply and recovery of said liquid are performed, the exposure approach including exposing said substrate is offered.
[0016]
In this invention, the device manufacture approach of using the aligner (EX) of the mode of the 1-4th either of the above is offered further.
[Effect of the Invention]
[0017]
According to this invention, even if a liquid flows out, this liquid that flowed out is recovered by the recovery system, without being left. Therefore, it can prevent un-arranging resulting from the liquid which flowed out, and the device which has a high pattern precision can be manufactured.
[Best Mode of Carrying Out the Invention]

[0018]
Although explained hereafter, referring to a drawing about the aligner and the device manufacture approach of this invention, this invention is not limited to this. Drawing 1 is the outline block diagram showing 1 operation gestalt of the aligner of this invention.
[0019]
The 1st operation gestalt
The mask stage MST where Aligner EX supports Mask M in drawing 1 The illumination-light study system IL which illuminates the mask M currently supported by the substrate stage PST which supports Substrate P, and the mask stage MST with the exposure light EL The projection optics PL which carries out projection exposure of the image of the pattern of the mask M illuminated with the exposure light EL at the substrate P currently supported by the substrate stage PST It has the liquid feeder 1 which supplies a liquid 50 on Substrate P, the recovery system 20 which collects the liquids 50 which flowed into the outside of Substrate P, and the control unit CONT which carries out generalization control of the actuation of the whole aligner EX.
[0020]
Here, with this operation gestalt, carrying out a synchronized drive for being suitable (hard flow), as an aligner EX, the case where the scanning aligner (the so-called scanning stepper) which exposes a mutually different pattern [in / for Mask M and Substrate P / a scanning direction] formed in Mask M to Substrate P is used is made into an example, and it explains. Let [the direction which is in agreement with the optical axis AX of projection optics PL] a direction (non-scanning direction) perpendicular to X shaft orientations, Z shaft orientations, and Y shaft orientations be Y shaft orientations for the direction of a synchronized drive of Mask M and Substrate P (scanning direction) in the following explanation in a flat surface perpendicular to Z shaft orientations and Z shaft orientations. Moreover, let the directions of the circumference of the X-axis, a Y-axis, and the Z-axis be thetaX, thetaY, and theta Z direction, respectively. In addition, a "substrate" here contains the reticle the "mask" had the device pattern by which contraction projection is carried out formed on a substrate including what applied the resist on the semi-conductor wafer.
[0021]
The illumination-light study system IL illuminates the mask M currently supported by the mask stage MST with the exposure light EL, and has the adjustable field diaphragm which sets up the lighting field on the condensing lens which condenses the exposure light EL from an optical integrator and an optical integrator which equalizes the illuminance of the flux of light injected from the light source for exposure, and the light source for exposure, a relay lens system, and the mask M by the exposure light EL in the shape of a slit. The predetermined lighting field on Mask M is illuminated by the illumination-light study system IL with the exposure light EL of uniform illumination distribution. As an exposure light EL injected from the illumination-light study system IL, vacuum-ultraviolet light (VUV light), such as far-ultraviolet light (DUV light), such as the bright line (g line, h line, i line) of an ultraviolet area, KrF excimer laser light (wavelength of 248nm), etc. which are injected, for example from a mercury lamp, and ArF excimer laser light (wavelength of 193nm), F2 laser beam (wavelength of 157nm), etc. is used. ArF excimer laser light is used with this operation gestalt.
[0022]
that to which a mask stage MST supports Mask M -- it is — the inside of a flat surface perpendicular to the optical axis AX of projection optics PL, i.e., XY flat surface, -- two-dimensional — minute to movable and theta Z direction -- it is pivotable. A mask stage MST is driven with the mask stage driving gears MSTD, such as a linear motor. The mask stage driving gear MSTD is controlled by the control unit CONT. The location of the two-dimensional direction of the mask M on a.mask stage MST and an angle of rotation are measured on real time by the laser interferometer, and a measurement result is outputted to a control unit CONT. A control device CONT positions the mask M currently supported by the mask stage MST by driving the mask stage driving gear MSTD based on the measurement result of a laser interferometer.
[0023]
Projection optics PL carries out projection exposure of the pattern of Mask M for the predetermined projection scale factor beta at Substrate P, it consists of two or more optical elements (lens), and these optical elements are supported by the lens-barrel PK as a metal member. In this operation gestalt, the projection scale factor beta of projection optics PL is the contraction system of 1/4 or 1/5. In addition, any of unit systems and an expansion system are sufficient as projection optics PL. Moreover, the optical element (lens) 60 is exposed to the tip side (Substrate P side) of the projection optics PL of this operation gestalt from Lens-barrel PK. This optical element 60 is formed possible [attachment and detachment (exchange)] to Lens-barrel PK.
[0024]
The substrate stage PST is equipped with Z stage 51 which holds Substrate P through a substrate holder, X-Y stage 52 which supports Z stage 51, and the base 53 which supports X-Y stage 52 in support of Substrate P. The substrate stage PST is driven with the substrate stage driving gears PSTD, such as a linear motor. The substrate stage driving gear PSTD is controlled by the control unit CONT. By driving Z stage 51, the location in the location (focal location) in Z shaft orientations of the substrate P currently held at Z stage 51 and thetaX, and the direction of thetaY is controlled. Moreover, the location (it is [the image surface of projection optics PL and] the location of an parallel direction substantially) in the XY direction of Substrate P is controlled by driving X-Y stage 52. That is, Z stage 51 controls the focal location and tilt angle of Substrate P, and doubles the front face of Substrate P with the image surface of projection optics PL by the automatic focus method and the auto leveling method, and X-Y stage 52 performs positioning in X shaft orientations and Y shaft orientations of Substrate P. In addition, it cannot be overemphasized that a Z stage and an X-Y stage may be prepared in one.
[0025]
On the substrate stage PST (Z stage 51), the migration mirror 54 which moves to projection optics PL with the substrate stage PST is formed. Moreover, the laser interferometer 55 is formed in the location which counters the migration mirror 54. The location of the two-dimensional direction of the substrate P on the substrate stage PST and an angle of rotation are measured on real time by the laser interferometer 55, and a measurement result is outputted to a control unit CONT. A control device CONT positions the substrate P currently supported by the substrate stage PST by driving the substrate stage driving gear PSTD based on the measurement result of a laser interferometer 55.
[0026]

With this operation gestalt, while shortening exposure wavelength substantially and improving resolution, in order to make the depth of focus large substantially, an immersion method is applied. Therefore, while imprinting the image of the pattern of Mask M on Substrate P at least, the predetermined liquid 50 is filled between the front face of Substrate P, and the apical surface (inferior surface of tongue) 7 of the optical element 60 by the side of the substrate P of projection optics PL (lens). As mentioned above, the lens 60 is exposed to the tip side of projection optics PL, and the liquid 50 is supplied so that only a lens 60 may be contacted. Thereby, the corrosion of the lens-barrel PK which consists of a metal etc. is prevented. Moreover, the apical surface 7 of a lens 60 is smaller than Lens-barrel PK and Substrate P of projection optics PL enough, and as mentioned above, since the liquid 50 is constituted so that only a lens 60 may be contacted, the liquid 50 has composition currently filled locally at the image surface side of projection optics PL. That is, the immersion part between projection optics PL and Substrate P is fully smaller than Substrate P. Pure water is used for a liquid 50 in this operation gestalt. Pure water can penetrate such exposure light EL, even when not only ArF excimer laser light but exposure light EL is made into far-ultraviolet light (DUV light), such as the bright line (g line, h line, i line) of an ultraviolet area, KrF excimer laser light (wavelength of 248nm), etc. which are injected from a mercury lamp.
[0027]
Aligner EX is equipped with the apical surface (apical surface of a lens 60) 7 of projection optics PL, the liquid feeder 1 which supplies the predetermined liquid 50 to the space 56 between Substrates P, and the liquid recovery system 2 as the 2nd recovery system which collects the liquids 50 50 of space 56, i.e., the liquid on Substrate P. The liquid feeder 1 is equipped with the temperature regulator which adjusts the temperature of the liquid 50 supplied to the tank and booster pump which it is and hold a liquid 50, and space 56 for filling the image surface side of projection optics PL with a liquid 50 locally. The end section of a supply pipe 3 is connected to the liquid feeder 1, and the supply nozzle 4 is connected to the other end of a supply pipe 3. The liquid feeder 1 supplies a liquid 50 to space 56 through a supply pipe 3 and the supply nozzle 4.
[0028]
The liquid recovery system 2 is equipped with the tank which holds a suction pump and the collected liquid 50. The end section of the recovery tubing 6 is connected to the liquid recovery system 2, and the recovery nozzle 5 is connected to the other end of the recovery tubing 6. The liquid recovery system 2 collects the liquids 50 of space 56 through the recovery nozzle 5 and the recovery tubing 6. In case a liquid 50 is filled to space 56, a control unit CONT drives the liquid recovery system 2, and collects the liquids 50 of the specified quantity from space 56 per unit time amount through the recovery nozzle 5 and the recovery tubing 6 while it drives the liquid feeder 1 and supplies the liquid 50 of the specified quantity per unit time amount to space 56 through a supply pipe 3 and the supply nozzle 4. Thereby, a liquid 50 is held and an immersion part is formed in the apical surface 7 of projection optics PL, and the space 56 between Substrates P. Here, a control unit CONT can set the amount of liquid recovery per unit time amount from Substrate P as arbitration by controlling the liquid recovery system 2 while being able to set the liquid amount of supply per [to space 56] unit time amount as arbitration by controlling the liquid feeder 1.
[0029]
Drawing 2 is the partial enlarged drawing of drawing 1 showing the lower part of the projection optics PL of Aligner EX, the liquid feeder 1, and liquid recovery-system 2 grade. In drawing 2 , point 60A leaves only a part required for a scanning direction, and the lens 60 of the lowest edge of projection optics PL is formed in Y shaft orientations (non-scanning direction) in the shape of [long and slender] a rectangle. At the time of scan exposure, some pattern images of Mask M are projected on the projection field of the rectangle [directly under] of point 60A, and Substrate P moves in the direction of +X (or the direction of -X) by rate beta-V (beta is a projection scale factor) through X-Y stage 52 to projection optics PL synchronizing with Mask M moving in the direction of -X (or the direction of +X) at a rate V. And after exposure ending to one shot field, the next shot field moves to a scan starting position by stepping of Substrate P, and exposure processing to each shot field is hereafter performed one by one by step - and - scanning method. With this operation gestalt, it is set up so that a liquid 50 may be poured in the same direction as the migration direction of Substrate P along the migration direction of Substrate P.
[0030]
Drawing 3 is drawing showing the physical relationship of point 60A of the lens 60 of projection optics PL, the supply nozzle 4 (4A-4C) which supplies a liquid 50 to X shaft orientations, and the recovery nozzle 5 (5A, 5B) which collects liquids 50. In drawing 3 , the configuration of point 60A of a lens 60 is the shape of a long and slender rectangle at Y shaft orientations, three supply nozzles 4A-4C are arranged at the direction side of +X, and two recovery nozzles 5A and 5B are arranged at the direction side of -X so that point 60A of the lens 60 of projection optics PL may be inserted into X shaft orientations. And the supply nozzles 4A-4C are connected to the liquid feeder 1 through a supply pipe 3, and the recovery nozzles 5A and 5B are connected to the liquid recovery system 2 through the recovery tubing 4. Moreover, the supply nozzles 8A-8C and the recovery nozzles 9A and 9B are arranged in the location which rotated the supply nozzles 4A-4C and the recovery nozzles 5A and 5B 180 degrees of abbreviation to the core of point 60A. The supply nozzles 4A-4C and the recovery nozzles 9A and 9B are arranged by turns by Y shaft orientations, the supply nozzles 8A-8C and the recovery nozzles 5A and 5B are arranged by turns by Y shaft orientations, the supply nozzles 8A-8C are connected to the liquid feeder 1 through a supply pipe 10, and the recovery nozzles 9A and 9B are connected to the liquid recovery system 2 through the recovery tubing 11.
[0031]
As shown in drawing 4 , on both sides of point 60A, the supply nozzles 13 and 14 and the recovery nozzles 15 and 16 can also be formed in each of Y shaft-orientations both sides. By this supply nozzle and the recovery nozzle, a liquid 50 can be stabilized and supplied between projection optics PL and Substrate P at the time of migration to the non-scanning direction (Y shaft orientations) of the substrate P at the time of carrying out step migration.
[0032]
In addition, especially the configuration of the nozzle mentioned above is not limited and may be made to perform supply or recovery of a liquid 50 with two pairs of nozzles about the long side of point 60A. In addition, in this case, in order to enable it to perform supply and recovery of a liquid 50 also from the which direction of the direction of +X, or the direction of -X, it may compare with a supply nozzle and a recovery nozzle up and down, and you may arrange.
[0033]

Next, it explains, referring to drawing 5 and drawing 6 about 1 operation gestalt of the recovery system 20 which collects the liquids which flowed into the outside of Substrate P. Drawing 5 is the perspective view of Z stage 51 (substrate stage PST), and drawing 6 is an important section expanded sectional view.
[0034]
The recovery system 20 is equipped with the liquid absorption member 21 arranged around the substrate P held on Z stage 51 at the holder section 57 in drawing 5 and drawing 6 . The liquid absorption member 21 is an annular member which has predetermined width of face, and is arranged in the slot 23 annularly formed on Z stage 51. Moreover, the passage 22 which follows a slot 23 is formed in the Z stage 51 interior, and the pars basilaris ossis occipitalis of the liquid absorption member 21 arranged in the slot 23 is connected to passage 22. The liquid absorption member 21 is constituted by foam, such as porous ceramics. Or the sponge which is foam as a formation ingredient of the liquid absorption member 21 may be used. Specified quantity maintenance of a liquid is possible for the liquid absorption member 21 which consists of foam.
[0035]
Between the substrates P currently held in the liquid absorption member 21 and the holder section 57 at the Z stage 51 top, the annular auxiliary plate section 59 which encloses the periphery of this substrate P by predetermined width of face is formed. The height of the front face of the auxiliary plate section 59 is set up so that it may be mostly in agreement with the height of the front face of the substrate P currently held at the holder section 57 of Z stage 51. Even when the boundary region (edge field) E of Substrate P is located under the lens 60 of projection optics PL by this auxiliary plate section 59, holding a liquid 50 can be being continued between the lens 60 of projection optics PL, and Substrate P. And the liquid recovery system 2 as the 2nd recovery system cannot recover the liquid absorption member 21 arranged so that the periphery of this auxiliary plate section 59 may be surrounded by predetermined width of face, and the role which absorbs the liquid 50 which flowed into the outside of the auxiliary plate section 59 (recovery) is played.
[0036]
The holder section 57 forms two or more lobes 58 for supporting the rear face of Substrate P in the circular crevice formed in the almost same magnitude as Substrate P on Z stage 51. The adsorption hole 24 for carrying out adsorption maintenance of the substrate P is formed in each of these lobes 58. And each of the adsorption hole 24 is connected to the passage 25 formed in the Z stage 51 interior. Moreover, two or more liquid recovery holes 46 are formed near the outermost periphery of the holder section 57 (circular crevice). These liquid recovery hole 46 is connected to the passage 22 linked to the liquid absorption member 21. In addition, passage where the passage 22 linked to the liquid absorption member 21 (slot 23) is another is prepared, and you may make it connect with the liquid recovery hole 46.
[0037]
The passage 22 connected to each of the liquid absorption member 21 and the liquid recovery hole 46 is connected to the end section of the duct 26 established in the Z stage 51 exterior. On the other hand, the other end of a duct 26 is connected to the pump 29 which is an aspirator through the 1st tank 27 and bulb 28 which were prepared in the Z stage 51 exterior. The passage 25 connected to the adsorption hole 24 is connected to the end section of the duct 30 established in the Z stage 51 exterior. On the other hand, the other end of a duct 30 is connected to the pump 33 which is an aspirator through the 2nd tank 31 and bulb 32 which were prepared in the Z stage 51 exterior. The liquids which flowed into the outside of Substrate P are collected from the liquid absorption member 21 and the liquid recovery hole 46 together with a surrounding gas (air). Moreover, the liquids which flowed into the rear-face side of Substrate P are collected from the adsorption hole 24 with a surrounding gas (air). The detail about these liquid recovery approaches is mentioned later. It separates into the liquid absorption member 21 and liquid recovery hole 46 list with a gas (air), and the liquid(water) collected from the adsorption hole 24 is temporarily accumulated in them at each of the 1st tank 27 and the 2nd tank 31. The inflow of the liquid to the vacuum pumps 29 and 33 as a source of a vacuum is prevented by this vapor liquid separation, and breakage of vacuum pumps 29 and 33 can be prevented. the 1st and 2nd tank 27 and 31 -- respectively -- being alike -- the outflow ways 27A and 31A prepare -- having -- **** -- water level -- a liquid is discharged from the specified quantity ******** outflow ways 27A and 31A using a sensor etc.
[0038]
In addition, passage where the passage 22 (a tank 27, a bulb 28, vacuum pump 29) linked to the liquid absorption member 21 (slot 23) is another is prepared, and you may make it connect with the liquid recovery hole 46. Moreover, in drawing 5 , migration mirror 54X which extends in Y shaft orientations is prepared in +X side edge section of Z stage 51, and migration mirror 54Y which extends in X shaft orientations is prepared in Y side edge section. A laser interferometer irradiates a laser beam at these migration mirrors 54X and 54Y, and detects the location in X shaft orientations and Y shaft orientations of the substrate stage PST.
[0039]
Next, the procedure which exposes the pattern of Mask M to Substrate P using the aligner EX mentioned above is explained.
[0040]
If Substrate P is loaded to the substrate stage PST while Mask M is loaded to a mask stage MST, a control unit CONT will drive the liquid feeder 1 and the liquid recovery system 2, and will form the immersion part of a liquid 50 in space 56 (refer to drawing 1). And a control unit CONT illuminates Mask M with the exposure light EL by the illumination-light study system IL, and projects the image of the pattern of Mask M on Substrate P through projection optics PL and a liquid 50. Here, while exposing the shot field near the center of Substrate P, the liquid 50 supplied from the liquid feeder 1 is collected with the liquid recovery system 2, and does not flow into the outside of Substrate P.
[0041]
On the other hand, although it can continue holding a liquid 50 between projection optics PL and Substrate P by the auxiliary plate section 59 when the immersion part between projection optics PL and Substrate P is near edge field E of Substrate P by carrying out exposure processing of the edge field E of Substrate P as shown in drawing 6 The fluid 50 with which some fluids 50 flow out and flowed into the outside of the auxiliary plate section 59 is absorbed by the liquid absorption member 21 (recovery). Here, a control device CONT starts disconnection of a bulb 28, and the drive of a pump 29 with drive initiation of the above-mentioned liquid feeder 1 and the liquid recovery system 2. Therefore, with

surrounding air, the liquid 50 collected by the liquid absorption member 21 is absorbed by the 1st tank 27 through passage 22 and a duct 26, and are made and collected by suction of the pump 29 as an aspirator.
[0042]
Moreover, the liquid 50 which flowed out of the clearance between Substrate P and the auxiliary plate section 59 is absorbed with surrounding air at a passage 22 side through the liquid recovery hole 46 prepared in the rear-face side of Substrate P, and are collected by the 1st tank 27 through a duct 26.
[0043]
Furthermore, it may flow into the adsorption hole 24 for the liquid 50 which entered into the rear-face side of Substrate P through the clearance between Substrate P and the auxiliary plate section 59 to carry out adsorption maintenance of the substrate P. Since the adsorption hole 24 is connected to the pump 33 as an aspirator through passage 25, a duct 30, and the 2nd tank 31 as mentioned above, while carrying out adsorption maintenance of the substrate P on Z stage 51 by performing disconnection of a bulb 32, and the drive of a pump 33, the liquid 50 which flowed into the adsorption hole 24 can be brought together in the 2nd tank 31 through passage 25 and a duct 30. That is, the 3rd recovery system which collects the liquids 50 which flowed into the adsorption hole 24 is equipped with passage 25, a duct 30, the 2nd tank 31, the bulb 32, the pump 33, and the control unit CONT that carries out these drive control. Moreover, the adsorption hole 24 at this time is functioning also as a liquid recovery hole (recovery system) prepared in the rear-face side of Substrate P.
[0044]
Moreover, although the liquid which turned to the rear face of Substrate P, and the gas on the rear face of substrate P (air) will flow like the liquid recovery hole 46, a liquid(water) and a gas (air) are separated from the adsorption hole 24 by dropping the 2nd tank 31. By collecting the liquids collected on the 2nd tank 31 periodically, the inflow of the liquid to the vacuum pump 33 as a source of a vacuum is prevented. In this way, he is trying to prevent breakage of a vacuum pump 33.
[0045]
By the way, when carrying out exposure processing of the edge field E of Substrate P (i.e., when the immersion part between projection optics PL and Substrate P is near the periphery of Substrate P), as mentioned above, some liquids 50 may flow into the outside of Substrate P. Even if a liquid 50 flows into the outside of Substrate P, so that between projection optics PL and Substrates P can fully be filled with this operation gestalt with a liquid 50 a control unit CONT When an immersion part is in the edge field E of Substrate P, the liquid feeder 1 is controlled and the liquid amount of supply per unit time amount to space 56 is made to increase, At least one side of controlling the liquid recovery system (the 2nd recovery system) 2, and reducing the amount of liquid recovery per unit time amount from space 56 is performed. In control of reduction here of the increment in the above-mentioned liquid amount of supply, and the amount of liquid recovery a control unit CONT Based on the substrate P location detection result of a laser interferometer, control of the liquid feeder 1 and/or the liquid recovery system 2 may be performed. Or the detection equipment which detects the amount of liquids collected (outflow) may be formed in the 1st and 2nd tank 27 and 32 or a duct 26, and 30 grades, and control of the liquid feeder 1 and/or the liquid recovery system 2 may be performed in them based on the detection result of this detection equipment.
[0046]
In addition, the aligner EX of this operation gestalt is the so-called scanning stepper. Therefore, when moving Substrate P to the scanning direction (the direction of -X) shown by the arrow head Xa (refer to drawing 3) and performing scan exposure, supply and recovery of a liquid 50 are performed by the liquid feeder 1 and the liquid recovery system 2 using a supply pipe 3, the supply nozzles 4A-4C, the recovery tubing 4, and the recovery nozzles 5A and 5B. namely, in case Substrate P moves in the direction of -X While a liquid 50 is supplied between projection optics PL and Substrate P from the liquid feeder 1 through a supply pipe 3 and the supply nozzle 4 (4A-4C) Liquids 50 are collected by the liquid recovery system 2 through the recovery nozzle 5 (5A, 5B) and the recovery tubing 6, and a liquid 50 flows in the direction of -X so that between a lens 60 and Substrates P may be filled. When moving Substrate P to the scanning direction (the direction of +X) shown by the arrow head Xb on the other hand and performing scan exposure, supply and recovery of a liquid 50 are performed by the liquid feeder 1 and the liquid recovery system 2 using a supply pipe 10, the supply nozzles 8A-8C, the recovery tubing 11, and the recovery nozzles 9A and 9B. namely, in case Substrate P moves in the direction of +X While a liquid 50 is supplied between projection optics PL and Substrate P from the liquid feeder 1 through a supply pipe 10 and the supply nozzle 8 (8A-8C) Liquids 50 are collected by the liquid recovery system 2 through the recovery nozzle 9 (9A, 9B) and the recovery tubing 11, and a liquid 50 flows in the direction of +X so that between a lens 60 and Substrates P may be filled. Thus, a control unit CONT pours a liquid 50 along the migration direction of Substrate P using the liquid feeder 1 and the liquid recovery system 2. Since the liquid 50 supplied through the supply nozzle 4 in this case from the liquid feeder 1 is drawn in space 56 with migration in the direction of -X of Substrate P, is made and flows, that the supply energy of the liquid feeder 1 is also small can supply a liquid 50 to space 56 easily. And also when scanning Substrate P by changing the direction which pours a liquid 50 according to a scanning direction in the which direction of the direction of +X, or the direction of -X, between the apical surface 7 of a lens 60 and Substrates P can be filled with a liquid 50, and high resolution and the large depth of focus can be obtained.
[0047]
As explained above, even if a liquid 50 flows into the outside of Substrate P, this liquid 50 that flowed out is recovered by the recovery system 20, without being left. therefore, the machine part of the substrate stage PST circumference which supports Substrate P while fluctuation of the environment where Substrate P is set is controlled -- rusting -- etc. -- since inconvenient generating of generating is also suppressed, precision can improve a pattern imprint to Substrate P, and the device which has a high pattern precision can be manufactured.
[0048]
Moreover, a liquid 50 can be certainly held in the large range by having formed the liquid absorption member 21 on the substrate stage PST as a recovery system 20 (recovery). Moreover, the liquid 50 absorbed by the liquid absorption member 21 is always discharged by the substrate stage PST exterior by having connected the pump 29 as an aspirator to the liquid absorption member 21 through passage. Therefore, while being able to control fluctuation of the environment where Substrate P is set, much more certainly, the weight fluctuation with the liquid 50 of the substrate stage PST can

be suppressed. Moreover, a pump 29 is stopped during exposure of a substrate, and the liquid 50 which flowed into the outside of Substrate P operates a pump 29, and you may make it hold to the liquid absorption member 21 etc. and discharge a liquid after the completion of exposure of a substrate. You may be the configuration which discharges the liquid 50 collected by the liquid absorption member 21 on the other hand, without forming a pump 29 to a tank 27 side with a self-weight. Furthermore, only the liquid absorption member 21 is arranged on the substrate stage PST, without preparing a pump 29, a tank 27, and passage, and it is good also as a configuration which exchanges periodically the liquid absorption member 21 which absorbed the liquid 50 (every [for example,] lot). In this case, although the substrate stage PST carries out weight fluctuation with a liquid 50, it is changing a stage control parameter according to the weight of the liquid 50 collected by the liquid absorption member 21, and stage positioning accuracy can be maintained.

[0049]

Moreover, since it has prevented that form the tanks 27 and 31 for separating a liquid(water) and a gas (air) before vacuum pumps 29 and 33, and a liquid infiltrates into vacuum pumps 29 and 33, failure and breakage of vacuum pumps 29 and 33 can be prevented.

[0050]

In addition, the vacuum pumps 29 and 33 in an above-mentioned operation gestalt may be arranged in Aligner EX, and may be installed in the works in which Aligner EX is installed. Moreover, although the vacuum system (this side of a vacuum pump) of a recovery system 20 which collects the liquids which flowed the tank for separating a liquid(water) and a gas (air) into the outside of Substrate P in the above-mentioned operation gestalt, and Substrate P were formed in the vacuum system for carrying out adsorption maintenance Installation of the devices (tank for liquid recovery etc.) for separating a liquid(water) and a gas (air) may be prepared in the inhalation-of-air system (vacuum system) connected to other inlets with a possibility that not only this but a liquid may permeate. For example, you may make it arrange the inhalation-of-air system or substrate attachment component for carrying out adsorption maintenance of the substrate P on a substrate stage at the inhalation-of-air system for enabling adsorption maintenance of the desorption on the gas recovery system (inhalation-of-air system) of a gas bearing, and a substrate conveyance arm. About the gas recovery system (inhalation-of-air system) of a gas bearing for example, about the inhalation-of-air system for carrying out adsorption maintenance of the substrate P, on a substrate conveyance arm at JP,11-166990,A for example, to JP,6-181157,A, about the inhalation-of-air system for enabling adsorption maintenance of the desorption of a substrate attachment component on a substrate stage again For example, as long as it is indicated by JP,10-116760,A, respectively and approves by the statute of a country specified or chosen by this international application, the written contents of these United States patents are used, and it carries out to a part of publication of the text. Moreover, in this operation gestalt, although applied to the aligner which exposes Substrate P, forming an immersion field in some fields on Substrate P for the device of the tank which separates a liquid(water) and a gas (air), you may apply to the aligner to which a substrate stage is moved in a cistern, and the aligner which forms a liquid tub on a substrate stage and holds a substrate in it. About the structure of the aligner to which a substrate stage is moved in a cistern, and exposure actuation for example, about the aligner which forms a liquid tub on a substrate stage and holds a substrate in it to JP,6-124873,A For example, it is indicated by JP,10-303114,A (U.S. Pat. No. 5,825,043), and as long as it approves by the statute of a country specified or chosen by this international application, the written contents of these reference are used and it carries out to a part of publication of the text.

[0051]

In addition, in the above-mentioned operation gestalt, although the liquid absorption member 21 is formed in annular [which continues so that the whole perimeter of Substrate P may be surrounded], it may be arranged in a part of perimeter of Substrate P, and may be arranged at intervals of predetermined at discontinuity. Moreover, although the liquid absorption member 21 in this operation gestalt is formed annularly, the configurations, such as the shape of a rectangle, can be set as arbitration, for example.

Moreover, neither the configuration of the liquid feeder 1 and the liquid recovery system 2 nor arrangement of a nozzle is restricted to the above-mentioned operation gestalt. Moreover, as long as the liquid feeder 1 and the liquid recovery system 2 do not need to be operating [be / not necessarily / it / under / exposure / of Substrate P / concurrency] and the exposure light optical path between projection optics PL and Substrate P is filled with the liquid 50, either may be stopped and both may be stopped.

[0052]

As mentioned above, the liquid 50 in this operation gestalt used pure water. Pure water has an advantage without the bad influence to a photoresist, an optical element (lens), etc. on Substrate P while being able to come to hand in large quantities easily by a semi-conductor plant etc. Moreover, since the content of an impurity is very low, pure water can also expect the operation which washes the front face of Substrate P, and the front face of an optical element established in the apical surface of projection optics PL, while not having a bad influence to an environment.

[0053]

And since the refractive index n of the pure water(water) to the exposure light EL whose wavelength is about 193nm is about 1.44, when ArF excimer laser light (wavelength of 193nm) is used as the light source of the exposure light EL, on Substrate P, it is short-wavelength-ized by 1/n, i.e., about 134nm, and high resolution is obtained. Furthermore, when what is necessary is just to be able to secure the depth of focus comparable as the case where it is used in air since the depth of focus is expanded [be / it / under / air / comparing] to about n times, i.e., about 1.44 times, it can make the numerical aperture of projection optics PL increase more, and its resolution improves also at this point.

[0054]

Although the lens 60 is attached at the tip of projection optics PL with this operation gestalt, as an optical element attached at the tip of projection optics PL, you may be the optical plate used for the optical property of projection optics PL, for example, adjustment of aberration (spherical aberration, comatic aberration, etc.). Or you may be the plane-parallel plate which can penetrate the exposure light EL. The optical element in contact with a liquid 50 by considering as a plane-parallel plate cheaper than a lens Even if the matter (for example, silicon system organic substance etc.) to which the permeability of projection optics PL, the illuminance of the exposure light EL on Substrate P, and the homogeneity of illumination distribution are reduced in the time of conveyance of Aligner EX, assembly, and adjustment etc. adheres to the plane-parallel plate There is an advantage that the exchange cost becomes low compared with the case where the

optical element in contact with a liquid 50 is used as a lens that what is necessary is just to exchange the plane-parallel plate just before supplying a liquid 50. Namely, although it is necessary to exchange the optical element periodically since the front face of the optical element which originates in adhesion of the impurity in the scattering particle generated from a resist by the exposure of the exposure light EL or a liquid 50 etc., and contacts a liquid 50 becomes dirty By using this optical element as a cheap plane-parallel plate, compared with a lens, the cost of a substitute part can be low, and can shorten time amount which exchange takes, and the rise of a maintenance cost (running cost) and the fall of a throughput can be suppressed.

[0055]

Moreover, when the pressure between the optical elements at the tip of projection optics and Substrates P which are produced by the flow of a liquid 50 is large, the optical element may not be made exchangeable, but you may fix strongly so that an optical element may not move with the pressure.

[0056]

In addition, what is necessary is just to use fluorine system liquids which can penetrate F2 laser beam as a liquid 50, such as fluorine system oil [for example,], polyether, etc. fluoride (PFPE), in this case, since this F2 laser beam does not penetrate water when the light source of for example, the exposure light EL which may be liquids other than water is F2 laser although the liquid 50 of this operation gestalt is water. Moreover, if it considers as a liquid 50, there is permeability over the exposure light EL, a refractive index is high as much as possible, and it is also possible to use a stable thing (for example, cedar oil) to the photoresist applied to projection optics PL and a substrate P front face.

[0057]

The 2nd operation gestalt

Next, other operation gestalten of the aligner EX of this invention are explained, referring to drawing 7 . in the following explanation, the sign same about a component the same as that of the operation gestalt mentioned above or equivalent is attached here, and simple in the explanation -- or it omits. The point of having replaced the characteristic part concerning this operation gestalt with the liquid absorption member 21 as a recovery system, and having established the liquid recovery slot 35 in the perimeter of Substrate P, and the substrate stage PST and a duct 26 are the points for which connection and separation are free.

[0058]

The recovery system 20 is equipped with the liquid recovery slot 35 formed around the auxiliary plate section 59 on Z stage 51 at predetermined width of face in drawing 7 . Moreover, the connection valve 36 is formed in the edge of passage 22. On the other hand, connection and the disengageable connection valve 37 are formed in the edge of a duct 26 to the connection valve 36. In the condition that the connection valves 36 and 37 are separated, the edge of passage 22 is blockaded and a fluid 50 flows into the stage exterior. On the other hand, by connecting the connection valves 36 and 37, the edge of passage 22 is opened wide and circulation of the liquid 50 of passage 22 is attained in a duct 26.

[0059]

The connection valve 36 and the connection valve 37 are separated during exposure processing. Therefore, since it is in the condition of having separated the substrate stage PST with the duct 26 during exposure processing, migration (scanning migration) to a scanning direction and migration (step migration) to a non-scanning direction can be performed smoothly. The liquid recovery slot 35 and passage 22 are covered with the liquid 50 which flowed out during exposure processing on the outside of Substrate P.

[0060]

If exposure processing is completed, the substrate stage PST will be moved to the exchange location (load unload location) of Substrate P. The connection valves 36 and 37 are connected in this substrate exchange location. If the connection valves 36 and 37 are connected, a control device CONT will drive a pump 29 while opening a bulb 28. Thereby, the liquid 50 collected in the liquid recovery slot 35 as a recovery system is discharged by the stage exterior in a substrate exchange location.

[0061]

in addition, the liquid 50 collected in this operation gestalt in the liquid recovery slot 35 -- being periodical (every [for example,] lot) -- since it is the configuration discharged by the stage exterior, the magnitude (volume) of the liquid recovery slot 35 is set as the magnitude of extent which can hold the liquid equivalent to the amount which flows out by part for one lot. In this case, it asks for the relation between predetermined exposure processing substrate number of sheets (a part for namely, one lot), and the amount of liquids flowing out beforehand, and the magnitude of the liquid recovery slot 35 is set up based on this relation for which it asked. Or based on said relation for which it asked, the time interval (namely, timing which performs liquid discharge actuation to the stage exterior) which connects the connection valves 36 and 37 is set up.

[0062]

In addition, in the above-mentioned operation gestalt, although the liquid recovery slot 35 is formed in annular [which continues so that the whole perimeter of Substrate P may be surrounded], it may be arranged in a part of perimeter of Substrate P, and may be arranged at intervals of predetermined at discontinuity. Moreover, although the liquid recovery slot 35 in this operation gestalt is formed annularly, it can set the configurations, such as the shape of a rectangle, as arbitration. Moreover, a liquid absorption member may be arranged in the liquid recovery slot 35.

[0063]

Moreover, you may make it form the liquid absorption member 21 and the liquid recovery slot 35 near the periphery of Substrate P in each above-mentioned operation gestalt, although the auxiliary plate section 59 is formed in the outside of Substrate P, without forming this auxiliary plate section 59.

[0064]

Moreover, although the aligner which fills a liquid locally between projection optics PL and Substrate P is adopted in an above-mentioned operation gestalt The recovery device in which the liquids which flowed into the adsorption hole for carrying out adsorption maintenance of the substrate P which is indicated by drawing 6 and drawing 7 are collected This invention is applicable also to the immersion aligner to which the stage holding the substrate for exposure is moved in a cistern, and the immersion aligner which forms the liquid tub of the predetermined depth on a stage, and holds a substrate in it. About the structure of an immersion aligner and exposure actuation which form the liquid tub of the predetermined

depth on a stage, and hold a substrate in it, for example to JP,6-124873,A about the structure of the immersion aligner to which the stage holding the substrate for exposure is moved in a cistern, and exposure actuation, it is indicated by JP,10-303114,A (U.S. Pat. No. 5,825,043), respectively, for example as above-mentioned.

[0065]

The 3rd operation gestalt

Hereafter, other operation gestalten of a recovery system are explained, referring to drawing 8 - drawing 10 .

[0066]

As shown in drawing 8 , the top face of the holder section 57 which the top face of Z stage 51 inclines and holds Substrate P is level. And the liquid recovery slot 35 is formed so that the perimeter of the holder section 57 may be surrounded. Although the liquid recovery slot 35 is annular in plane view at this time, it inclines in side view. That is, the liquid recovery slot 35 is formed along the inclination of the top face of Z stage 51. Thereby, the liquid 50 which flowed into the outside of Substrate P collects on inclination lower 35A of the liquid recovery slot 35 automatically. By that as used in the field of [in case liquids 50 are collected] only by collecting the liquids 50 collected on this inclination lower 35A, recovery actuation can be performed easily.

[0067]

As shown in drawing 9 (a), the liquid recovery slot 35 is established in the top face of Z stage 51 part. The liquid recovery slot 35 is covered with a liquid 50 by carrying out exposure processing. And as shown in drawing 9 (b), the liquids 50 collected on this liquid recovery slot 35 are collected through the tube 38 attached in the transport device H which carries out the load unload of the substrate P to the substrate stage PST. The tube 37 which constitutes some aspirators attracts the liquid 50 collected on the liquid recovery slot 35, when a transport device H accesses to the substrate stage PST, in order to carry out the unload of the substrate P which exposure processing ended from the substrate stage PST.

[0068]

The 4th operation gestalt

Moreover, still more nearly another operation gestalt of a recovery system is explained below. As shown in drawing 10 (a), the liquid recovery slot 35 is established in the top face of Z stage 51. The liquid recovery slot 35 is connected to the passage 39 penetrated to the inferior-surface-of-tongue side of Z stage 51. Bulb 39A is prepared in passage 39. Moreover, corresponding to the passage 39 of Z stage 51, the passage 40 and 41 which is a through tube is formed in each of X-Y stage 52 and the base 53. Bulb 39A is closed during exposure processing, and as shown in drawing 10 (a), the liquid recovery slot 35 is covered with a liquid 50. And if exposure processing is completed, a control device CONT will move the substrate stage PST to a substrate exchange location, and will open bulb 39A. Thereby, as shown in drawing 10 (b), the liquid 50 of the liquid recovery slot 35 is discharged by the stage exterior with a self-weight through passage 39, 40, and 41 in a substrate exchange location. In addition, although it is desirable to perform recovery of the liquid 50 of the liquid recovery slot 35 in a substrate exchange location, it may be made to do a discharge activity in a location other than a substrate exchange location.

[0069]

The 5th operation gestalt

By the way, in each operation gestalt mentioned above, while the liquid feeder 1 supplies a liquid 50 on Substrate P from the upper part of Substrate P through the supply nozzle 4 Although the immersion field is formed in the part on Substrate P because the liquid recovery system 2 as the 2nd recovery system collects the liquids 50 on Substrate P from the upper part of Substrate P through the recovery nozzle 5 You may make it the recovery system 20 in which it was prepared on the substrate stage PST recover almost all the liquids 50 supplied on Substrate P, without forming the liquid recovery system 2 (recovery nozzle 5) above Substrate P, as shown in drawing 11 . The supply nozzles 4 and 8 prepared in each of the scanning direction (X shaft orientations) both sides which faced across the projection field (optical element 60) of projection optics PL are illustrated by drawing 11 . When carrying out scan exposure of the substrate P, in case a liquid 50 is supplied, you may make it supply a liquid 50 from the supply nozzle of either of the supply nozzles 4 and 8 according to the migration direction of Substrate P, or may make it supply a liquid 50 to coincidence from both supply nozzles 4 and 8. On Substrate P, the liquid 50 supplied from the liquid feeder 1 spreads greatly, and can form a big immersion field. And although the liquid 50 supplied on Substrate P flows into the outside of Substrate P soon as shown in the perspective view of drawing 12 , all are mostly recovered by the recovery system 20 which has the slot 23 (liquid absorption member 21) established in the surroundings of Substrate P as recovery opening. While the liquid feeder 1 can form an immersion field good on Substrate P by continuing supply of a liquid 50 to Substrate P top during the exposure processing to Substrate P here Since the liquid 50 on Substrate P can be made to produce flow with the supplied liquid 50, while carrying out the firm gas of the fresh (clarification) liquid 50 on Substrate P, the liquid 50 on Substrate P can be poured to a slot 23.

[0070]

The liquid recovery system 2 as the above-mentioned 2nd liquid recovery system is a configuration which carries out suction recovery of the liquid 50 on Substrate P using a vacuum system through the recovery nozzle 5 from the upper part of Substrate P, it is collecting a liquid(water) and gases (air) together, and the liquid may produce a sound and vibration in recovery tubing 6 wall etc. In this case, the sound under exposure of Substrate P and generating of vibration can be prevented by collecting liquids 50 only using the recovery system 20 prepared in the substrate stage PST like the operation gestalt shown in drawing 11 and drawing 12 , without performing suction recovery of the liquid 50 from the upper part of Substrate P.

[0071]

In addition, in the case of this operation gestalt which does not collect liquids from the upper part of Substrate P, the configuration shown in drawing 7 in the 2nd operation gestalt as a recovery system 20 may be used. Since the vacuum pump 29 is not attracting the liquid collected during exposure of Substrate P in the liquid recovery slot 35, in the case of drawing 7 , generating of the sound accompanying suction of the liquid or vibration can also be suppressed, and it is still more effective for it.

Moreover, the liquid recovery system 2 which collects liquids from the upper part of Substrate P through the recovery nozzle 5 is arranged like the operation gestalt explained previously, and only a recovery system 20 recovers a liquid,

without operating the liquid recovery system 2, and it may be [the liquid recovery system 2 and a recovery system 20 are used together, and] made to collect liquids 50 after the completion of exposure of Substrate P during exposure of Substrate P. Also in this case, the effect of the sound accompanying suction (recovery) of the liquid under exposure of Substrate P or vibration can be suppressed.
[0072]
In addition, as a substrate P of each above-mentioned operation gestalt, not only the semi-conductor wafer for semiconductor device manufacture but the glass substrate for display devices, the mask used with the ceramic wafer for the thin film magnetic heads or an aligner or the original edition (synthetic quartz, silicon wafer) of a reticle, etc. is applied.

[0073]
It is applicable also to the projection aligner (stepper) of the step-and-repeat method which one-shot exposure of the pattern of Mask M is carried out [method] in the condition of having stood still Mask M and Substrate P other than the scanning aligner (scanning stepper) of step - which carries out the synchronized drive of Mask M and the substrate P, and carries out scan exposure of the pattern of Mask M as an aligner EX, and - scanning method, and carries out step migration of the substrate P one by one. Moreover, this invention can apply at least two patterns also to the aligner of step - imprinted in piles partially and - SUTITCHI method on Substrate P.
[0074]
As a class of aligner EX, it is not restricted to the aligner for semiconductor device manufacture which exposes a semiconductor device pattern to Substrate P, but can apply to the aligner for manufacturing an aligner, the thin film magnetic head, an image sensor (CCD), a reticle or a mask for the object for liquid crystal display component manufacture, or display manufacture, etc. widely.
[0075]
Moreover, this invention is also applicable to the aligner of a twin stage mold. About the structure of the aligner of a twin stage mold, and exposure actuation, it is indicated by reference, such as JP,10-163099,A, JP,10-214783,A, the ** table No. 505958 [2000 to] official report, a U.S. Pat. No. 6,341,007 number, No. 6,400,441, No. 6,549,269, and No. 6,590,634, and they can be referred to. As long as it approves by the statute of a country specified or chosen by this international application, those United States patents are applied and are carried out to a part of publication of the text.
[0076]
When using a linear motor for the substrate stage PST and a mask stage MST, whichever of the magnetic levitation mold using the air surfacing mold and the Lorentz force, or the reactance force which air bearing was used may be used. Moreover, the type which moves along with a guide is sufficient as each stages PST and MST, and they may be guide loess types which do not prepare a guide. The example which used the linear motor for the stage is indicated by U.S. Pat. No. 5,623,853 and 5,528,118, as long as it approves by the statute of a country specified or chosen by this international application, respectively, uses the written contents of these reference and carries out them to a part of publication of the text.
[0077]
The flat-surface motor which the magnet unit which has arranged the magnet to two dimensions, and the armature unit which has arranged the coil to two dimensions are made to counter as a drive of each stages PST and MST, and drives each stages PST and MST according to electromagnetic force may be used. In this case, what is necessary is to connect either of a magnet unit and an armature unit to Stages PST and MST, and just to establish another side of a magnet unit and an armature unit in the migration side side of Stages PST and MST.
[0078]
The reaction force generated by migration of the substrate stage PST may be mechanically missed to the floor (earth) using a frame member so that it may not get across to projection optics PL. As long as it is indicated by JP,8-166475,A (U.S. Pat. No. 5,528,118) at the detail and approves by the statute of a country specified or chosen by this international application, the art of this reaction force uses the written contents of this reference, and carries out to a part of publication of the text.
[0079]
The reaction force generated by migration of a mask stage MST may be mechanically missed to the floor (earth) using a frame member so that it may not get across to projection optics PL. As long as it is indicated by JP,8-330224,A (U.S. Pat. No. 5,874,820) at the detail and approves by the statute of a country specified or chosen by this international application, the art of this reaction force uses the written contents of this reference, and carries out to a part of publication of the text.
[0080]
as mentioned above, the aligner EX of this application operation gestalt -- this application -- it is manufactured by assembling the various subsystems containing each component mentioned to the claim so that a predetermined mechanical precision, electric precision, and optical precision may be maintained. In order to secure these various precision, before and after this assembly, adjustment for attaining electric precision is performed about the adjustment for attaining mechanical precision about the adjustment for attaining optical precision about various optical system, and various mechanical systems, and various electric systems. Like the assembler from various subsystems to an aligner, the mechanical connections between [various] subsystems, wiring connection of an electrical circuit, piping connection of an atmospheric-pressure circuit, etc. are included. It cannot be overemphasized that it is in the front like the assembler from these various subsystems to an aligner like the assembler of each subsystem each. If it ends like the assembler to the aligner of various subsystems, comprehensive adjustment will be performed and the various precision as the whole aligner will be secured. In addition, as for manufacture of an aligner, it is desirable to carry out in the clean room where temperature, an air cleanliness class, etc. were managed.
[0081]
As micro devices, such as a semiconductor device, are shown in drawing 13 With the aligner EX of step 201 which performs the function and engine-performance design of a micro device, step 202 which manufactures the mask (reticle) based on this design step, step 203 which manufactures the substrate which is the base material of a device, and the operation gestalt mentioned above It is manufactured through the exposure processing step 204 which exposes the

pattern of a mask to a substrate, the device assembly step (a dicing process, a bonding process, and a package process are included) 205, and inspection step 206 grade.

[Brief Description of the Drawings]

[0082]

[Drawing 1] It is the outline block diagram showing 1 operation gestalt of the aligner of this invention.
[Drawing 2] It is drawing showing physical relationship with the point of projection optics, a liquid feeder, and a liquid recovery system.
[Drawing 3] It is drawing showing the example of arrangement of a supply nozzle and a recovery nozzle.
[Drawing 4] It is drawing showing the example of arrangement of a supply nozzle and a recovery nozzle.
[Drawing 5] It is the perspective view showing 1 operation gestalt of a recovery system.
[Drawing 6] It is the important section expanded sectional view showing 1 operation gestalt of a recovery system.
[Drawing 7] It is the important section expanded sectional view showing other operation gestalten of a recovery system.
[Drawing 8] It is the perspective view showing other operation gestalten of a recovery system.
[Drawing 9] It is the typical sectional view showing other operation gestalten of a recovery system.
[Drawing 10] It is the typical sectional view showing other operation gestalten of a recovery system.
[Drawing 11] It is drawing showing other operation gestalten of the liquid recovery actuation by the recovery system.
[Drawing 12] It is drawing showing other operation gestalten of the liquid recovery actuation by the recovery system.
[Drawing 13] It is the flow chart Fig. showing an example of the production process of a semiconductor device.
[Drawing 14] It is drawing for explaining the conventional technical problem.

[Description of Notations]

[0083]

1 [-- Liquid absorption member,] -- A liquid feeder, 2 -- A liquid recovery system, 20 -- A recovery system, 21
24 [-- The 2nd tank,] -- An adsorption hole, a recovery hole, 27 -- The 1st tank, 29 -- A pump, 31
33 [-- Control unit,] -- A pump, 35 -- A liquid recovery slot, 50 -- A liquid, CONT
EX [-- Substrate stage] -- An aligner, P -- A substrate, PL -- Projection optics, PST

[Translation done.]

DESCRIPTION OF DRAWINGS

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[Drawing 14] It is drawing for explaining the conventional technical problem.

[Translation done.]

* NOTICES *

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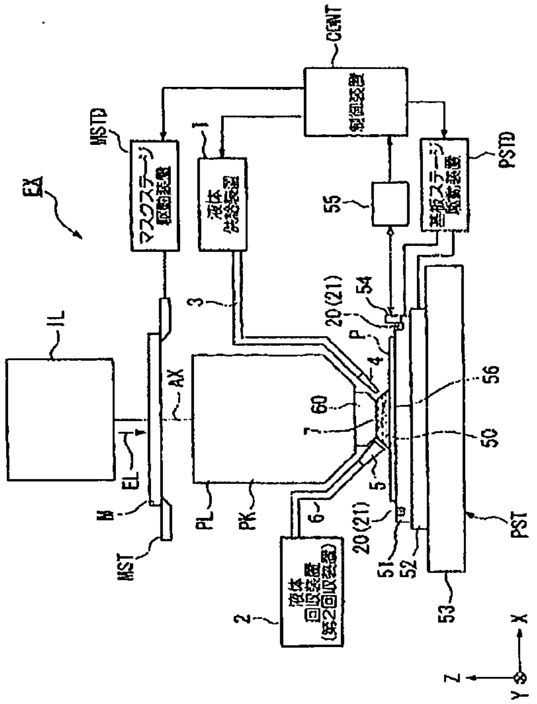
damages caused by the use of this translation.

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

[Drawing 1]



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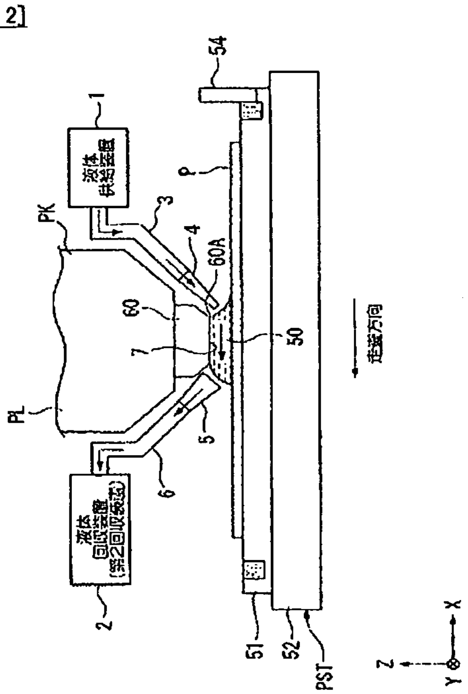

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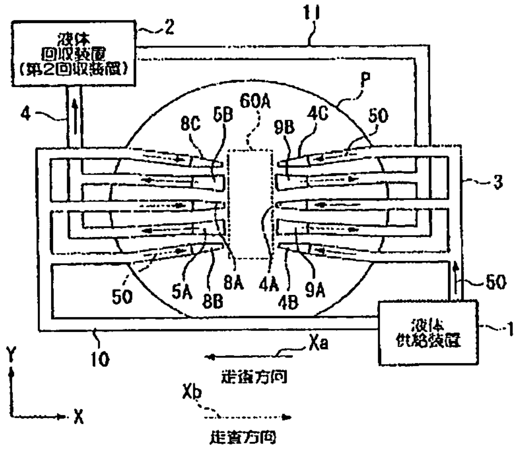

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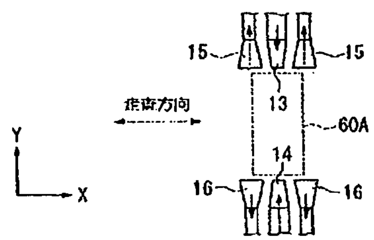

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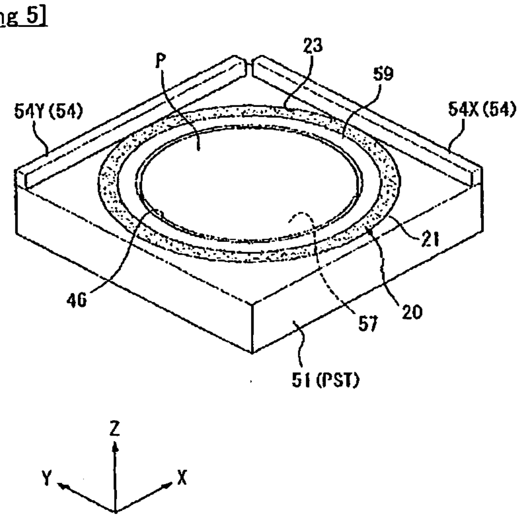

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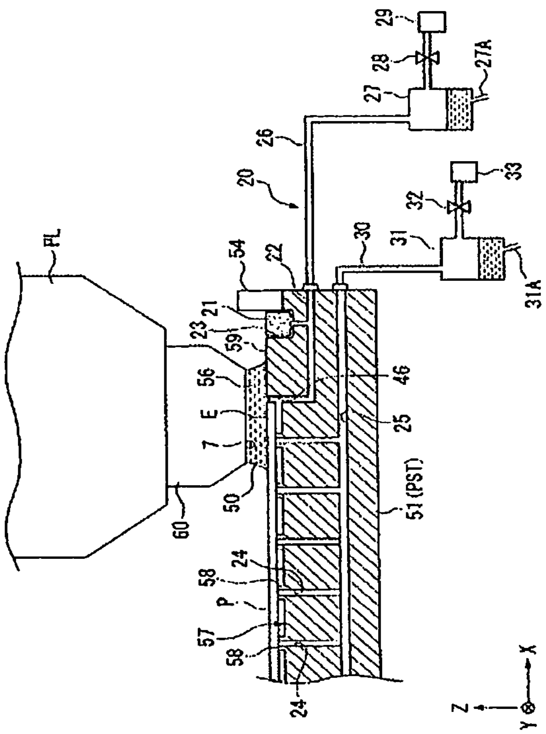

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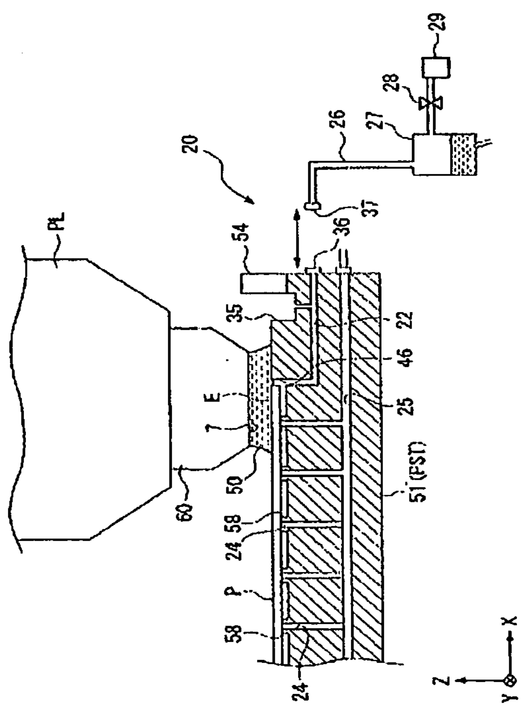

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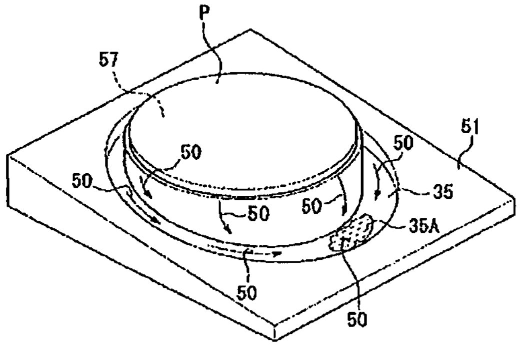

[Drawing 9]

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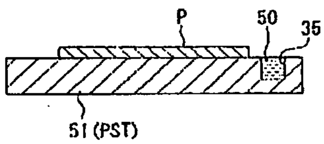

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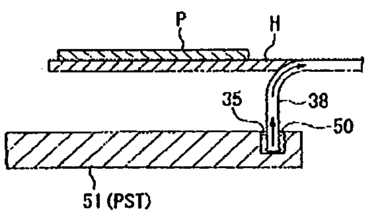

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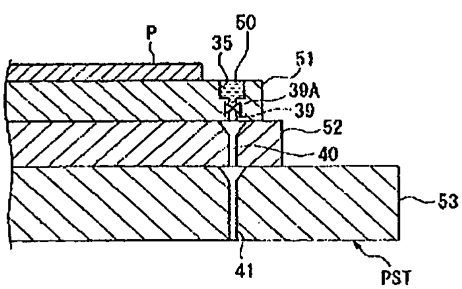

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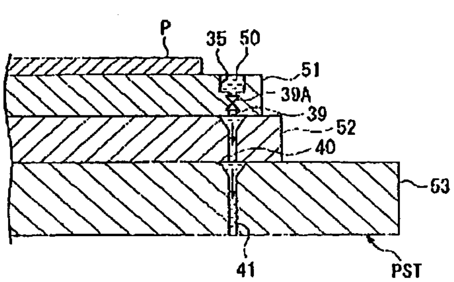

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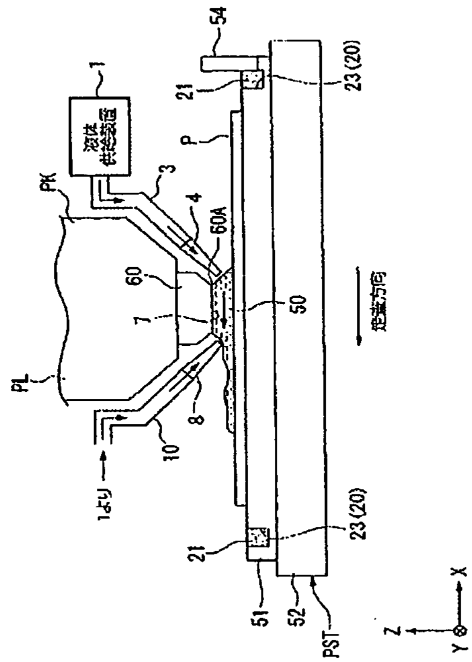

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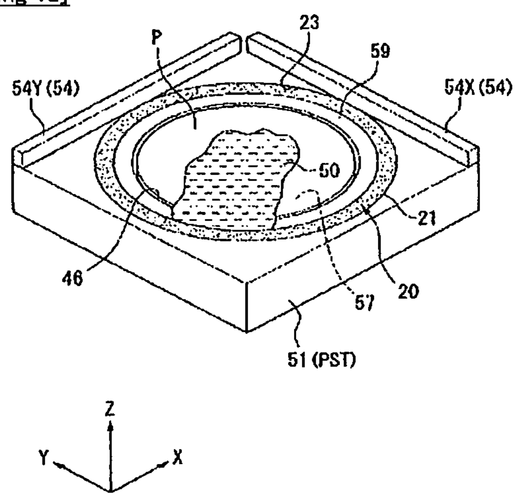
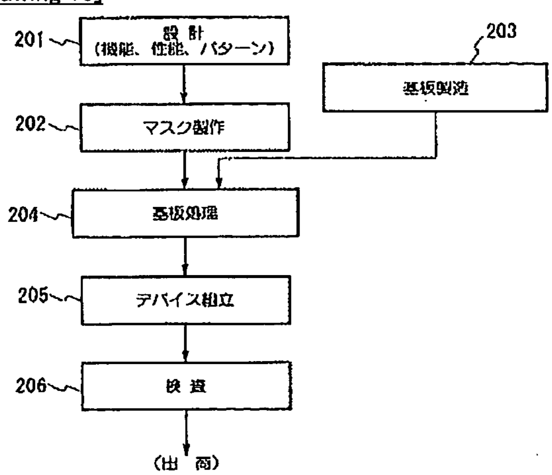
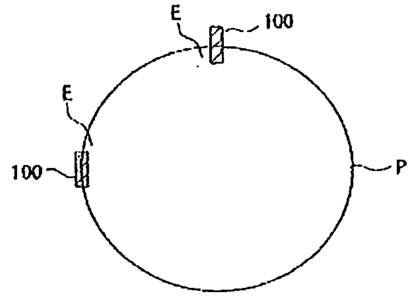


[Drawing 13]



[Drawing 14]



[Translation done.]